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Base Instrument Cluster (Kombi)

Model: E39 and E53 with base cluster

Production: Start of Production

OBJECTIVES

After completion of this module you will be able to:

- Compare the base instrument cluster with the IKE
- Understand the functions of the base instrument cluster
- Diagnose concerns with the base instrument cluster

Base Instrument Cluster

The base instrument cluster differs from the high version cluster by lack of the IKE. All processing is performed internally in the cluster. Also, there is no Check Control display matrix, but rather a check control pictogram.

The cluster consists of five analog gauges. The processing electronics and drivers for the gauges are contained in the cluster. The five gauges include:

- Fuel Gauge
- Speedometer
- Tachometer
- Fuel Economy Gauge
- Coolant Temperature



Three Liquid Crystal Display blocks are provided for the:

- Check Control Display - pictogram
- Mileage, Outside Temperature and BC Display
- Transmission Range and SI Display

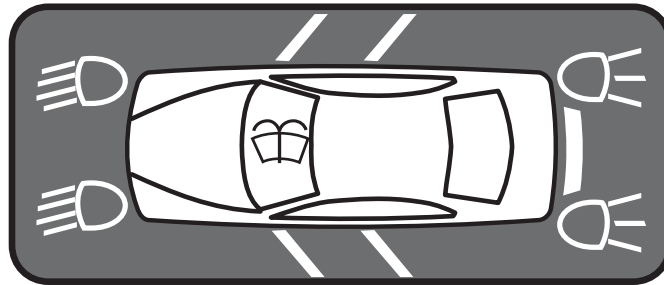
Warning lamps and indicators are positioned to the left and right of the display blocks. The number of warning lamps is greater on the base cluster for the display of several check control warnings. All of the warning lamps and indicators are LEDs and not replaceable.

Critical warning lamps use two LEDs for a safety margin.

There are replaceable lamps for the back lighting on the liquid crystal display units.

The **Left Display Block** contains a pictogram for various check control warnings. LED's within the display will illuminate for:

- Lighting failures for headlight (low beam),taillight and brake lights.
- Open doors or trunk
- Low washer fluid



Additional circuits monitored by check control include the oil level and transmission emergency program. These warnings are indicated by lamps positioned in both indicator display areas on the left and right sides on the bottom of the instrument cluster.

Due to the ability to illuminate multiple warning LEDs, there is no priority displays for the pictogram check control. If multiple faults exist, each corresponding LED will illuminate.

The LED will remain illuminated as long as the fault exists. The only exception is the washer fluid which will go out 60 seconds after KL 15 is switched ON.

All check control and lamp control circuits are monitored by the Light Check Module (LCM). When failures or faults exist, the messages are passed to the cluster for display over the K-Bus.

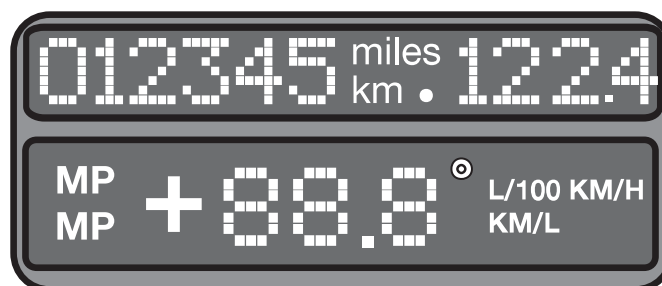
The **Middle Block** contains the displays for the Total Mileage, Trip Mileage and Board Computer.

The total mileage is stored in non-volatile memories in the cluster EEPROM and the LCM.

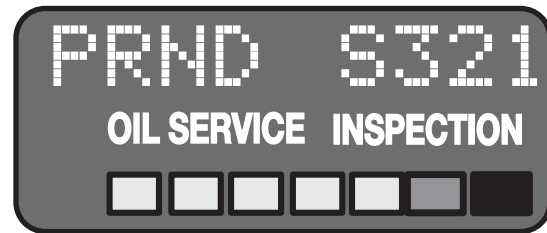
The mileage can be displayed with the key off for 25 seconds if the mileage reset button is pressed.

Board Computer information can be displayed by pressing the turn signal lever.

NOTE: The outside temperature is displayed automatically every time the key is switched ON.



The **Right Block** contains the displays for the automatic transmission driving range and the Service Interval Indicator III.



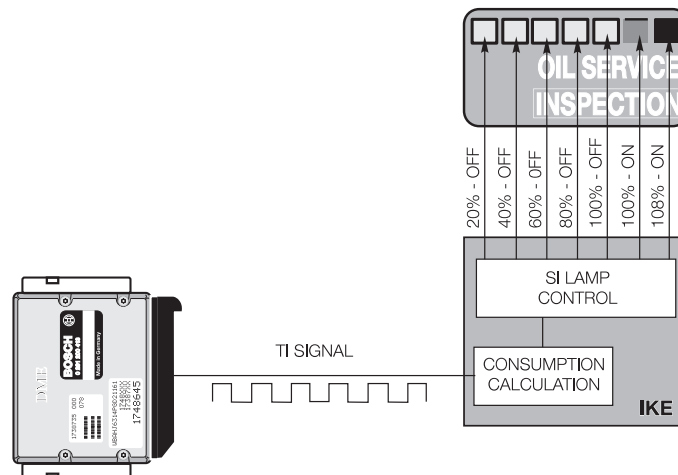
The display of the Service Indicator on the E39 is the same as previous systems. The processor for the intervals is located in the cluster electronics. However, the processing method for determining interval times has changed. The E39 uses the new Service Interval III system. Interval times are based on fuel consumption instead of mileage and starts. This system was introduced on the 1996 E38 750iL was subsequently phased into the other models.

Using fuel consumption offers several advantages over the previous method for determining oil service.

- First, the processing electronics are less involved in that only one value is needed for the processing.
- Second, the use of fuel consumption is a more accurate method of determining engine load and the need for service.
- Third, resetting of the indicator before the scheduled time will not effect the time to the next service.

A set volume of fuel (in liters) is stored in the EEPROM of the SI. The volume of fuel is dependent on the vehicle and engine size. The processor receives the “ti” signal as the vehicle is used. As 20% of the stored volume is consumed, one of the green LEDs will go out. Each successive 20% of fuel consumption will cause the next LED to go out until 100% of the stored volume has been consumed. At this point the yellow LED will come on indicating the service is due. At 108% of the volume, the RED LED will illuminate indicating an over due service.

With every reset, the total volume of fuel is restored in the EEPROM and the calculation starts over again.



Dynamic Digital Inputs

Distance Signal

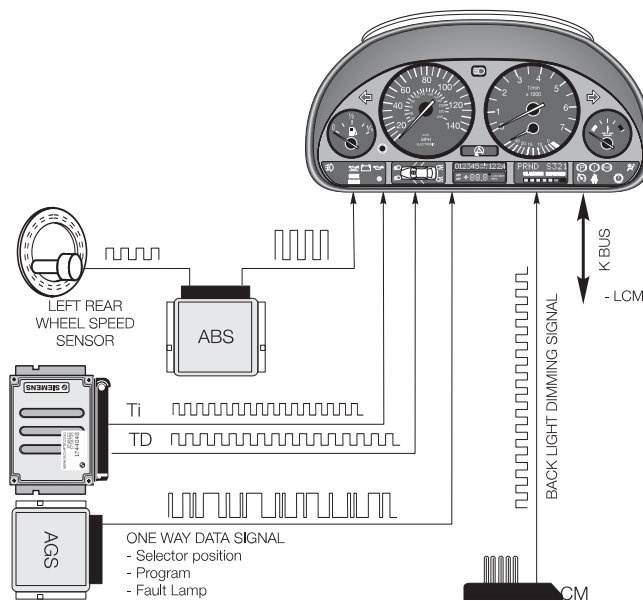
This input is supplied to the cluster by the ABS/ASC+T (or DSC) control module as a square wave signal. Pulses from the left rear wheel speed sensor are processed by the ASC/DSC module to produce this signal. The cluster electronics process the input for the cluster display and pass the signal along, on the K-Bus, as speed signal “A” for other control modules requiring the vehicle speed signal.

Engine Control Module Signals

The “Ti” & “TD” signals are produced by the engine control module (DME) and sent to the cluster. On models produced before 9/98, the “Ti” and “TD” signals were sent to the cluster via a dedicated signal line.

From 9/98, these signals are sent to the cluster via the CAN-Bus.

The cluster processes the signals for the tachometer and fuel economy indicator displays. The Ti signal is used by the cluster for the SI indicator. The cluster also passes the TD signal out over the K Bus.



Transmission One Way Data Signal

The transmission control module (EGS/AGS), provides a one way data signal to the instrument cluster for signalling of the range selector position, driving program and for fault lamp activation.

From 9/98, the transmission information is sent to the cluster via the CAN-Bus.

Dimmer Signal

This is a pulse-width modulated signal from the LCM. It is used to control the intensity of the back lighting of the instruments and the LCDs when the lights are switched ON. This signal is also output over the “K” Bus.

K-Bus Signalling

The Cluster receives signals for the Check Control Pictogram over the K-Bus.

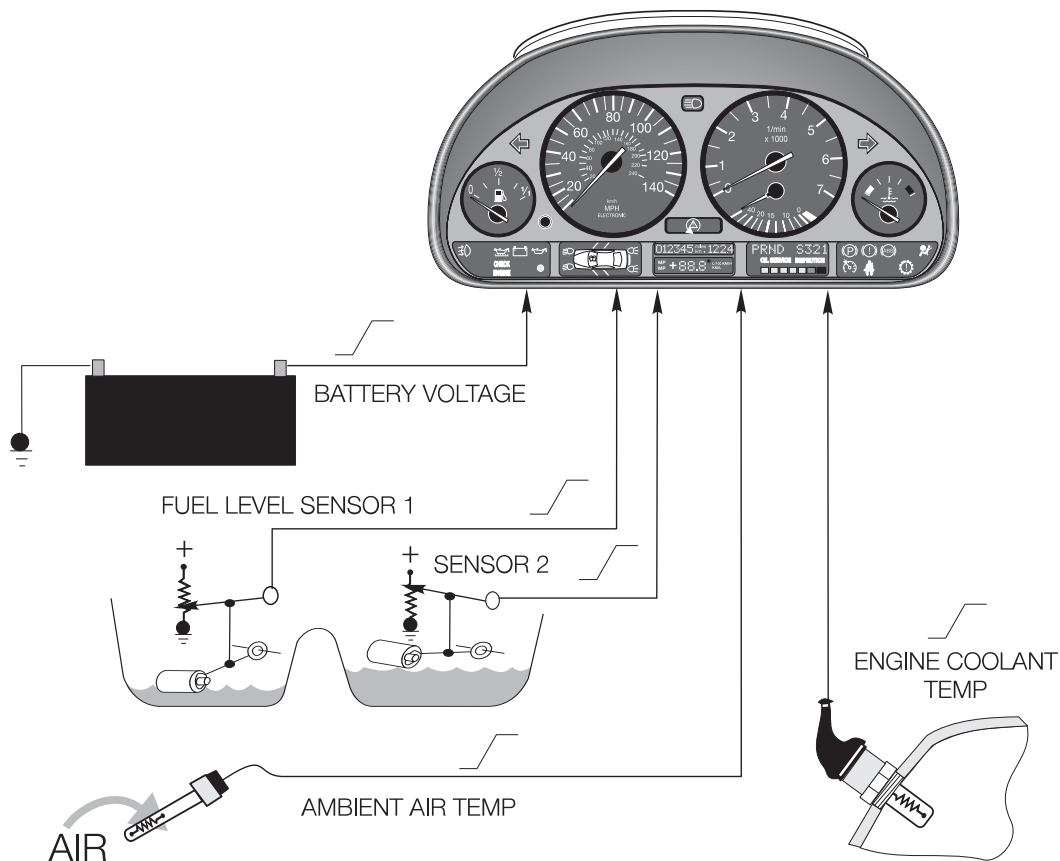
Analog Input Signals

Battery Voltage

Battery voltage is monitored by the cluster and a fault is stored if the voltage exceeds 16 volts

Fuel Tank Level

Two lever action sensors are wired in parallel to the cluster. The two varying voltage signals are processed by the cluster for fuel gauge and low fuel warning display.



Coolant Temperature

A NTC sensor is used to measure coolant temperature the cluster uses this input for temperature gauge display. The NTC sensor is a dual NTC, one of the NTC circuits is an input to DME, the other NTC is an input to the cluster.

From 9/98, the coolant temperature sensor is an input to the DME only, the cluster receives the temperature information via the CAN-Bus. The dual NTC is eliminated.

Outside Temperature Sensor

A NTC sensor is used to measure the ambient temperature. The signal is processed by the cluster and passed out over the K Bus to modules requiring this input for processing.

Digital Input Signals

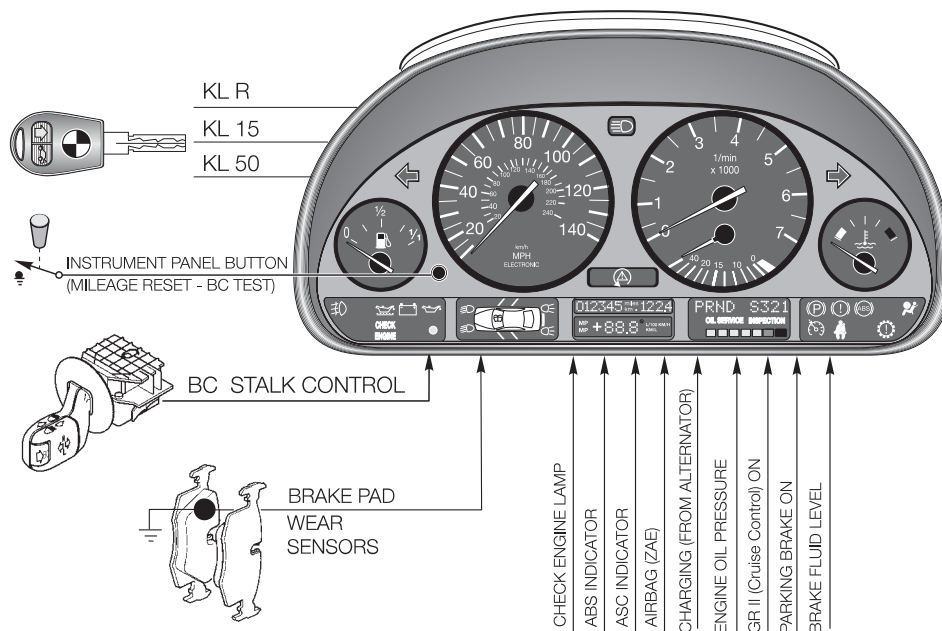
The normal ignition switch terminals (KL R, KL 15 & KL 50) are input to the cluster. Various functions are dependent on ignition switch position.

Steering Column Switch (LSS)

As with previous systems the turn signal stalk is used to call up BC functions. The LSS is also referred to as the BC stalk control switch. It provides a ground input to the cluster.

Brake Pad Wear Sensors

The pad sensor inputs are used to illuminate the brake pad warning indicator as in the past.



Instrument Panel Button

The reset button is used to reset the trip odometer as in the past. It will also display the mileage, if pressed with the key switched OFF. This button is also used for the Base BC/instrument cluster test functions.

Inputs for Warning Lamps

Various switches are used to signal the cluster for warning and indicator lamp illumination including:

- Engine Oil Pressure
- Check Engine Lamp (MIL) from the ECM (DME)
- ASC/DSC/ABS warning lamps
- Parking Brake indicator

Some of these inputs are now provided via bus systems such as the CAN or K-Bus.

Output Signals

Speed Signal “A”

The vehicle speed signal is available as an output for control modules that require precise vehicle speed information.

“K” Bus Interface

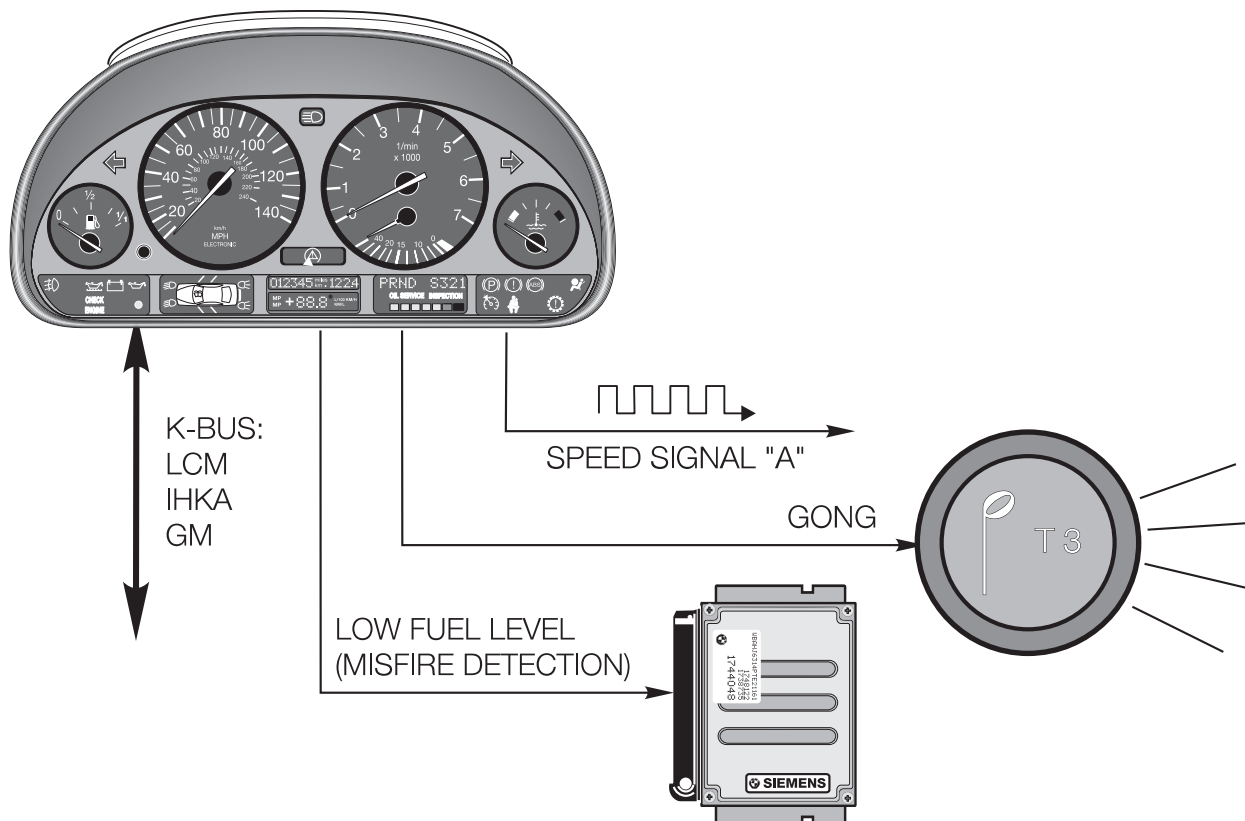
The K Bus is used to transfer data between the cluster and other modules on the link. The diagnostic interface also passes over the K Bus for troubleshooting with the DISplus/GT-1.

Low Fuel

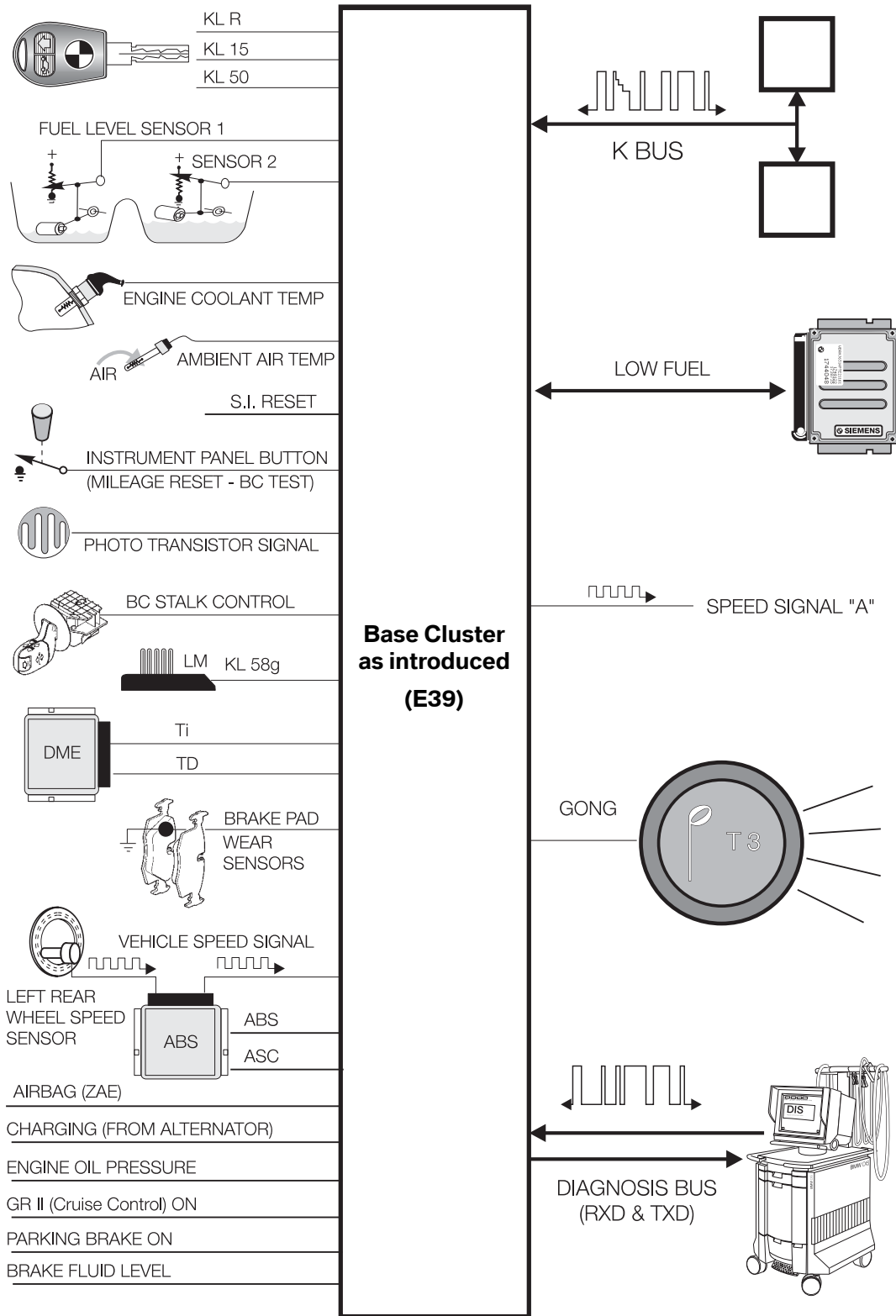
Based on the processing for the low fuel indicator lamp, this output is also sent to the engine control module (ECM). The signal is stored along with a misfire detection fault for troubleshooting purposes.

Gong Output

T3, The T3 tone is used for check control warnings.



Base Cluster Overview IPO (as introduced to 9/98)

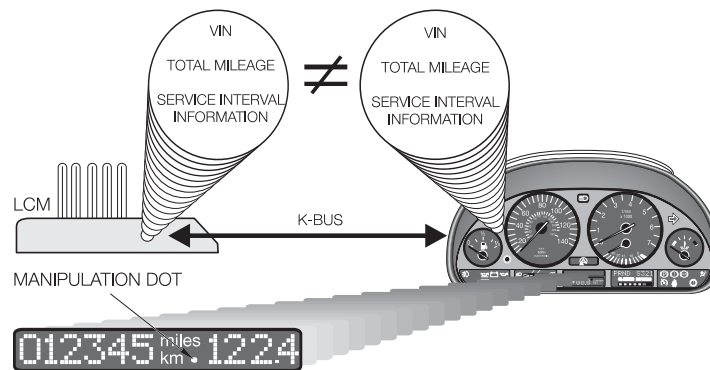


Redundant Data Storage

The specific information stored redundantly includes:

- Vehicle ID number
- Total mileage
- Service Interval data

The data is stored in the cluster and in the Light Check Module (LCM). The storage of this data follows the redundant storage of the E38. It prevents the loss of total mileage or SI data in the event of a cluster processor failure.



The data is compared each time KL 15 is switched ON. If the data does not match, the manipulation DOT in the mileage display is illuminated.

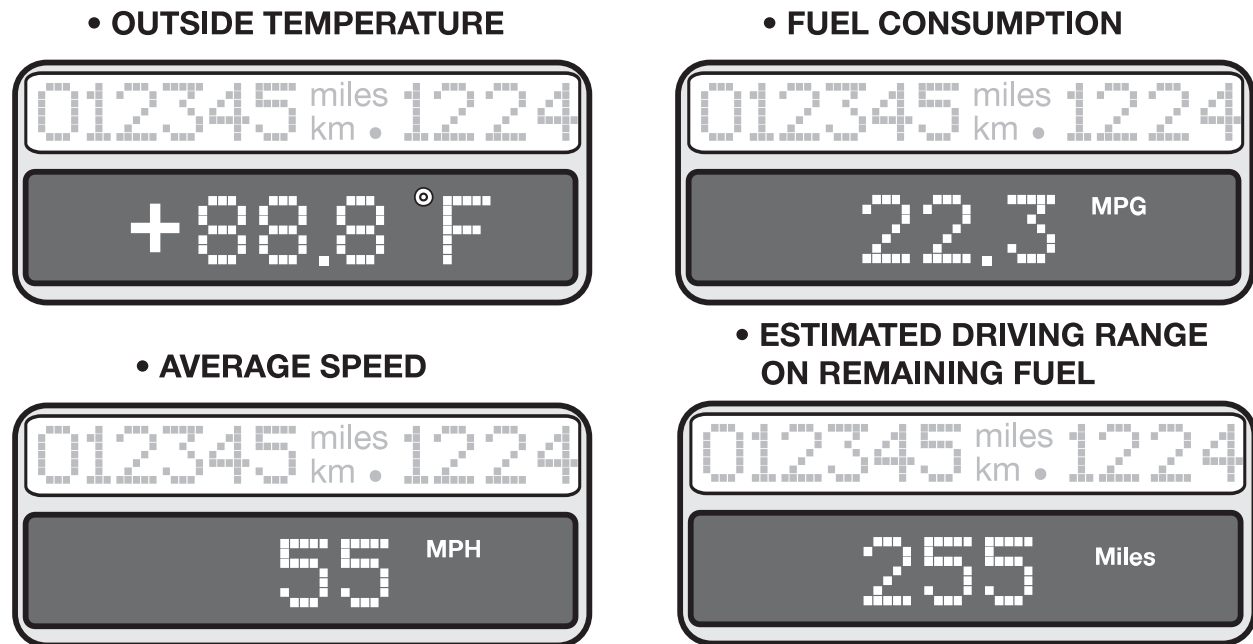
Because of this redundant storage feature, the following points must be noted:

1. If the vehicle ID number is not the same in both modules, the manipulation DOT is illuminated and no data transfer takes place. All functions of both modules will continue to operate.
2. Data will only be accepted by the cluster from the LCM if the ID numbers match and the cluster mileage is zero.
3. The vehicle ID number is input into the cluster through coding and will only be accepted when the cluster is at zero mileage.
4. The LCM stored mileage can only be overwritten with a higher mileage and is updated every 60 miles.
5. If the mileage differs by more than 120, and the ID numbers are the same, the cluster will continue recording the mileage and set a fault for data transfer.
6. If the K Bus link to the LCM fails, the cluster will continue to record mileage and store a fault for the data link.

These conditions will only allow new components to be installed for replacement purposes. However, a used component can be installed for testing purposes. If a cluster from another vehicle is used for testing purposes, road testing of the vehicle should be avoided, because the cluster will accumulate mileage.

On Board Computer (Base Cluster)

The On Board computer information on the base variant cluster can only be displayed in the center matrix. The following information can be displayed:



On vehicles up to the 98 model year, when KL R is switched ON, the outside temperature will be displayed. To call up any other function, the turn signal lever must be pressed and released. The other functions are then displayed one after the other. A blank field is provided after the average speed display to allow the driver to switch off the display.

On vehicle from 98, the display which was last called up will be retained when KLR is switched back on.

A freeze warning is incorporated in the BC. If the temperature drops below 37OF, the gong will sound and the temperature display will flash in the BC. Pressing the turn signal lever will cancel the display.

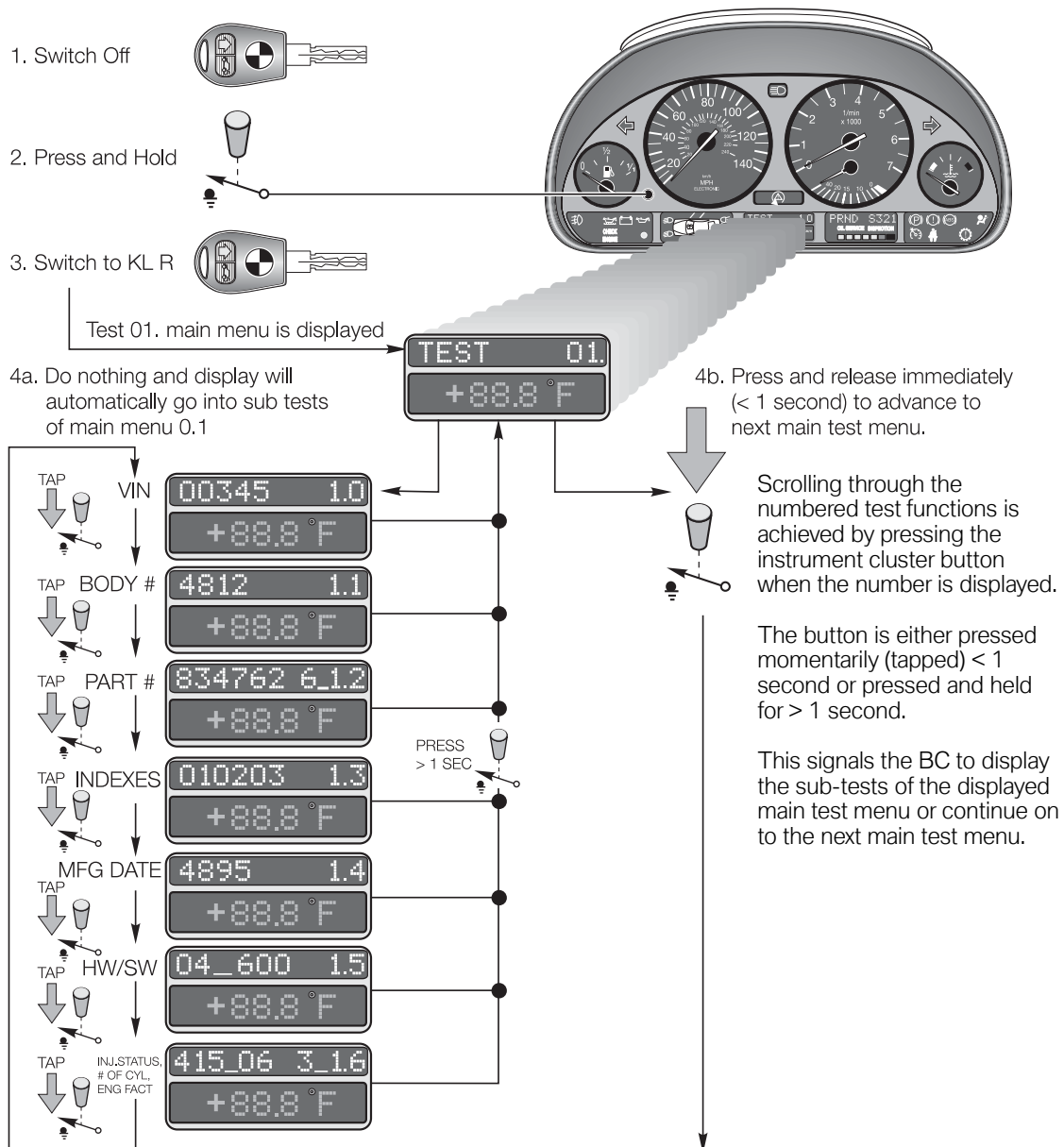
Two of the displays "Average Fuel Consumption" and "Average Speed" can be reset to start new calculations. To reset the displays, press and hold the turn signal lever, for longer than one second, when the function is called up. The BC will then start to compute a new average value.

Base BC/Instrument Cluster Test Functions

In addition to the fault memory and diagnostic link, the base instrument cluster contains a series of test functions that can be accessed to check various functions and values. The test functions are displayed in the mileage LCD block. There are a total of 21 test functions.

The test functions are similar to those of previous Board computers and contain similar tests.

- Tests 1 & 2 are always unlocked.
- Tests 3 -21 are only accessible after unlocking the test function. Test 19 is the unlock function for accessing the displays.



Test No. 1

Vehicle specific data including:

Sub-Tests:

12345 1.0 = VIN

4812 1.1 = Body number

834762 6_1.2 = Part number of cluster

010203 1.3 = Coding/Diagnosis/Bus index

3495 1.4 = Manufacturing date (calendar week/year)

04_600 1.5 = Hardware/software # of cluster (HW:04, SW:6.00)

415_06 3_1.6 = Injection status, number of cylinders, engine factor

Test No. 2

Cluster System Test - activates the gauge drivers, indicators and LEDs to confirm function.

Test No. 3

SI data

Sub Tests:

1500 3.0 = Liters

0 3.1 = Periodic inspection days (not applicable for US).

Test No. 4

Momentary Consumption

Sub Tests:

0267 4.0 = 26.7 liters/1000km

0073 4.1 = 7.3 liters per hour

Test No. 5

Distance Gone Consumption

Sub Tests:

0195 5.0 = 19.5 liters/100 km

226 5.1 = momentary distance to go (226km)

Test No. 6

Fuel level sensor inputs in liters

Sub Tests:

237415 6.0 = Fuel level averaged

- LH sensor input = 23.7 liters
- RH sensor Input = 41.5 liters

0652 6.1 = Total tank level averaged = 65.2 liters

0667 1_6.2 = Indicated value and tank phase

- 1 = both sensors OK
- 2 = one sensor fault
- 3 = implausible input

Test No. 7

Temperature and Speed

Sub Tests:

032 7.0 = Coolant temp input 32OC

245 7.1 = Outside temp input 24.5OC

5283 7.2 = Engine speed 5,283 RPM

058 7.3 = Vehicle speed 58km/H

Test No. 8

Input values in HEX form

Sub Tests:

XXX 8.0 - 8.3 = Hex code, Instrument cluster inputs

Test No. 9

Battery voltage

Sub Test:

125 9.0 = 12.5 volts

Test No. 10

Country Coding

Sub Test:

02 10.0 = US 02

Test No. 11

Cluster code

Sub Test:

000003 11.0 = Cluster code

Test No. 12

Not used

Test No. 13

GONG test

Sub Test:

Gong 13.0 = Activate gong by pressing button (gong response is delayed).

Test No. 14

Fault memory (not for diagnosis)

Test No. 15-18

Not used

Test No. 19

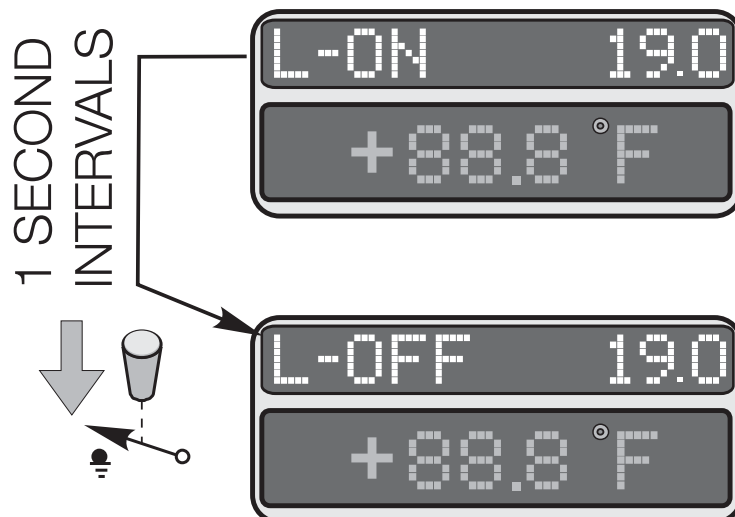
LOCK/UNLOCK

Sub-Tests

L-ON...

L-OFF 19.0 =

Display changes from “L-ON” to “L-OFF” every second. To unlock test functions, press the cluster button immediately when it changes to “L-OFF”. Tests are automatically locked when exiting test functions.



Test No. 20

Average fuel consumption - correction factor

The factor follows previous systems, with adjustment range of 750 to 1250. The adjustment method is new for the base cluster. If adjustment is necessary, enter into test 20 using the cluster button. The correction factor number is changed by using the sub-tests for the “ones, tenths and hundreds of the factor number. The digits will automatically scroll through 0-9 within each group (ones, tenths, hundreds).

Sub-Tests:

XXX9 20.0 = Press the button when the correct “ones” position is attained.

XX5X 20.1 = Press the button when the correct “tenths” position is attained.

12XX 20.2 = Press the button when the correct “hundreds” position is attained.

Test No. 21

Software reset

Sub-Test:

reset 21.0 = Reset software



Workshop Exercise

Using an instructor designated vehicle, enter the instrument cluster test functions using the proper procedure. Access all test steps and complete worksheet.

Explain the proper procedure to unlock the instrument cluster:

Perform Test 02

How is this test useful in diagnosis?

Perform Test 20

How is this test useful in diagnosis?

How is Test Step 21 useful in diagnosis?



Workshop Exercise

Using an instructor designated vehicle, connector the appropriate test cables to the instrument cluster. Access the correct ETM and complete worksheet below.

What is the KL30H signal used for?

Using the oscilloscope measure the KL58g signal. Record observations below. Operate the dimmer switch from low to high and observe oscilloscope.

What are the readings obtained from the KL58g signal?

Monitor CAN-Bus using oscilloscope and record observations below?

Disconnect CAN-Bus from instrument cluster and observe (faults/functions etc.)

What was observed on the cluster with the CAN-Bus disconnected?

Disconnect the ambient temperature sensor input to the instrument cluster (or unplug sensor).

What happens to the temperature display? What other system are affected?



Classroom Exercise - Review Questions

1. What vehicles use the base instrument cluster?

2. How are lamp failures and low fluid levels displayed on the base instrument cluster?

3. What is displayed in the “middle display block” on the base cluster?

4. Explain SIA III processing as compared to SIA II?

5. How can the instrument cluster test functions be used to diagnose fuel gauge complaints?



Classroom Exercise - Review Questions

6. What is the difference between coolant temperature input in vehicles before and after 9/98 production?

7. What is the “low fuel” output signal used for?

8. What information is stored redundantly between the cluster and LCM?

9. Why should the cluster and LCM not be replaced simultaneously?

10. What instrument cluster test functions are always unlocked?
